Positive and Negative Impacts of Dive Tourism: The Case Study of Utila, Honduras.

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Submitted in fulfilment of the requirements for the International Master's Programme in Environment Studies and Sustainability Science.

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Abstract

Utila one of three islands comprising the Bay Islands off the North coast of Honduras, it situated in the Caribbean Sea and is part of the second largest barrier reef system in the world. It is a small island approximately 11km and 4km at its widest point, with an estimated population of 8500. Utila has undergone an economic transformation over the past 30 years, based around low-budget dive tourism that is centred upon the coral reefs surrounding the island. The expansion of this industry triggered the economic and development of the island, giving rise to higher living standards and increasing the well-being of the population. The population has rapidly increased due to the emigration of people from the Honduran mainland seeking employment and a higher standard of living. Resulting from this development has been the increased stress upon the natural resources and increased pressure upon land for development, in addition to the pressures of an increasing population. The pressure upon land for development has led to increasing encroachment into mangrove forests, which is an illegal activity, which has caused the loss and degradation of many ecosystem services, most importantly are those connected to the functioning and health of the coral reef system. The coral reef and associated ecosystems must be managed if Utila is to continue to base its economy upon dive tourism.

Keywords; tourism, development, stakeholder analysis, coral reefs, mangroves.

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Acknowledgments

Thanks to Utila Centre for Marine Ecology for the use of office space and equipment, and general help given during my stay on Utila. Thanks to family, friends and supervisor who have helped out in many capacities.

1.0 Introduction

In recent decades increasing attention has been focused upon coral reefs worldwide, due to an increasing use of these natural environments and their associated ecosystem services. For centuries the resources of the coral reef have been exploited, used as important fishing grounds, utilised as building materials, and their role in coastal protection has allowed human settlement in otherwise inhabitable areas (Alongi, 2002; Windevoxhel et al., 1999). Coral reefs are now increasingly under threat from direct and indirect anthropogenic activities (Sebens, 1994), many of these actions are synergistic thus accelerating the deterioration of this important ecosystem (Harborne et al., 2001).

Global warming is driving changes in a variety of important climatic processes that directly impact coral reefs. Sea surface-temperatures have increased worldwide, the Caribbean has incurred more frequent El Nino (Southern Oscillation) events, resulting in mass coral bleaching events (Wilkinson et al., 1999, cited in Souter and Lindén, 2000). In addition the Caribbean is now experiencing longer hurricane seasons, with more numerous and powerful hurricane events per year (Sebens, 1994). Hurricanes can cause severe damage to coral reefs through the physical damage of wave action associated turbidity that carries sediment onto the reef. A healthy reef is able to show signs of recovery from such events within a relatively short time period, many reefs are now showing a limited amount of recovery due to anthropogenic activities which further stress and degrade this fragile ecosystem (Sebens, 1994). Two important ecosystems associated with coral reefs are, mangroves and seagrass beds, complex interactions and energy flows occur between these ecosystems (Alongi, 2002). As a result of these interactions the health of one of these ecosystems is an integral part to the health of the other ecosystems. According to Zorini et al., (2004) “mangroves are among the most threatened ecosystems in the world”, yet to many coastal communities they provide invaluable ecosystem services, they are the primary defences for coastal erosion, particularly during storms and hurricane events. In addition they provide sediment binding and stabilisation, bio-filtration, wave dissipation (Saenger, 2001). Mangrove forests are becoming increasingly threatened worldwide as human populations grow (Zorini et al., 2004). Extensive areas of mangrove in Asia and Central America are being turned into shrimp ponds to satisfy an increasing global demand, whilst urban encroachment to house expanding populations is a growing trend (Holguin et al., 2006). The anthropogenic activities most affecting coral reefs are effluent discharges in the form of fertilisers and sewage, which cause eutrophication, sedimentation rates rise due to increasing development and deforestation (Stonich, 1998). The growing dive tourism industry promotes these changes, in addition to the direct impact of over diving particular sites and the associated ‘kick-damage’, which damages individual coral colonies (Rouphael and Hanafy, 2007).

Over fifty-five percent of the Worlds population inhabits coastal zones, utilising the coastal and marine environments for food, recreation, tourism and waste disposal (Adeel and Pomeroy, 2002). The social and economic importance of coral reefs and mangroves are increasing due to a growing reliance upon the associated ecosystem services. In Mexico, Holguin et al., (2006) estimated that a hectare of mangrove produces 750kg of fish and shellfish per year for the local fisheries. Traditionally local populations have sustainably managed the environment on which they rely, but as global demand for goods and services increases exploitation of these resources is increasing (Adeel and Pomeroy, 2002). Decline in fisheries is associated with habitat destruction; approximately 90% of tropical commercially important fish species are connected to the reef and mangrove ecosystems (Mumby, 2006). Thus the future of these ecosystems is vital to the economy

of coastal communities and the future social dynamics of the local populations. The exploitation of reef resources for tourism is becoming an increasing trend and to small islands it makes up an integral part of their economy (Souter and Lindén, 2000). Many countries associated with coral reefs are emerging nations or developing countries where development and economy are prioritised over the environment (Dahdouh-Guebas, 2002).

The economic and social sustainability of many communities and countries associated with coral reefs is dependent upon the survival of this resource and the associated ecosystems. The difficulty of ensuring sustained economic growth and maintaining a level of living standards and quality of life is that they are dependent upon the utilisation of the marine resources. Between these three elements of sustainability, economic, societal and environmental, trade-offs will have to be made to try to balance the dynamics of the system (Franks and Falconer, 1999). By focusing purely on one facet the other two will deteriorate and consequently will decrease all elements of sustainability. An integral part of sustainability is the institutions, be it governmental or non-government organisations (NGO's), their integrity and how the stakeholders will be involved in the decision process, and take a long-term responsibility will be key to the future of the communities associated with these areas and the future existence of the environments. This often requires a considerable financial investment, to ensure strong capacity building including the employment of experienced and appropriate staff, to ensure effective management of the marine resources and ensure the acceptance and cooperation of local communities (Wilkinson et al., 2006). The aim of this paper is to identify the key drivers behind the destructive processes occurring on Utila and offer recommendations on how to deal with these problems, based upon successful case studies in similar locations. The scope of this study is based upon the anthropogenic activities and their affects to the environment and the socio-economic elements of Utila.

2.0 Background

Honduras is the third largest country in Central America, after Mexico and Nicaragua, with a land area of 47 000 square miles (Glantz and Jamieson, 2000). It consists of many important ecosystems, namely rainforests, cloud forests and the southern extent of the Mesoamerican barrier reef, the second largest barrier reef in the world (Harborne et al., 2001). The importance of these environments has been recognised at the global level and now due to the ratification of various treaties and conventions, national parks and reserves have been established (Aguilar-Støen and Dhillion, 2003). The federal government has introduced strict legislation concerning the utilisation of these resources; an important one is the protection of mangroves (Windevoxhel et al., 1999). The problem with these laws is enforcement; limited funding is given to the monitoring and protection of these national parks and reserves. Corruption within Honduras is high therefore illegal activities such as illegal logging of mangroves is a common occurrence (Harborne et al., 2001).

The Gross Domestic Product per capita (Purchasing Power Parity) is $3000, and over 50% of the population is below the poverty line (Glantz and Jamieson, 2000). Primary exports of Honduras are coffee and fish and shellfish, coffee is a particularly important export, worth US$995.3 million annually (UN, 2005). The unsustainable practices of the coffee industry have led to large areas of deforestation and sedimentation of rivers and coastal areas is an increasing problem, in addition to deforestation due to the timber industry (Harborne et al., 2001). The shrimp industry is a growing sector, annual export value of US$697.1 million (UN, 2005) and many coastal areas are converting mangrove forests into shrimp ponds, to supply the demand for this product in America and Europe (Alongi, 2002). A growing industry within Honduras is tourism, now estimated to be worth US$450 million annually (Luxner, 2007). The rapid expansion of this industry has concentrated development along coastal zones throughout the 1990's, especially in the Bay Islands (Harborne et al., 2001). The Bay Islands have been dramatically affected by events upon the mainland, in 1998 hurricane Mitch devastated large areas of the Honduran mainland mudslides, as a result of the unsustainable practices of the coffee and timber industries, destroyed basic infrastructures and thousands lost their lives (Harborne et al., 2001). The destruction of banana plantations, the main stay of the Honduran economy at the time, devastated the economy, estimates of an export loss of US$900 million, the depressed economy and obliteration of the country's infrastructure severely affected the population (Glantz and Jamieson, 2000). The increased economic hardship encountered by the mainland population by this event and the comparatively limited damaged sustained by the Bay Islands (with the exception of Gunaja) has lead to a significant migration of poor and uneducated mainlanders to the Bay Islands seeking employment (Harborne et al., 2001).

The Bay Islands or Islas de la Bahia, found off the north coast of Hondurans in the Caribbean Sea, consist of three islands, Roatán, Utila and Guanaja (figure 1). Utila is the smallest of the three islands measuring 11km long by 4km at its widest point. The majority of Utila is at sea-level, the highest peak being Pumpkin Hill at the west of the island, which reaches 24metres, the remainder of the island lies within a few meters of sea-level. The island is dominated by mangrove and swampland vegetation, (figure 2). Four types of mangrove exist on Utila, the red mangrove (*Rhizophora mangle*), the black mangrove (*Avicennia germinans*), the white mangrove (*Laguncularia racemosa*), and the buttonwood mangrove (*Conocarpus erectus*). The red and black mangroves are the most dominant species upon the island, and are an important habitat for an endemic species of iguana (*Ctenosaura backeri*).

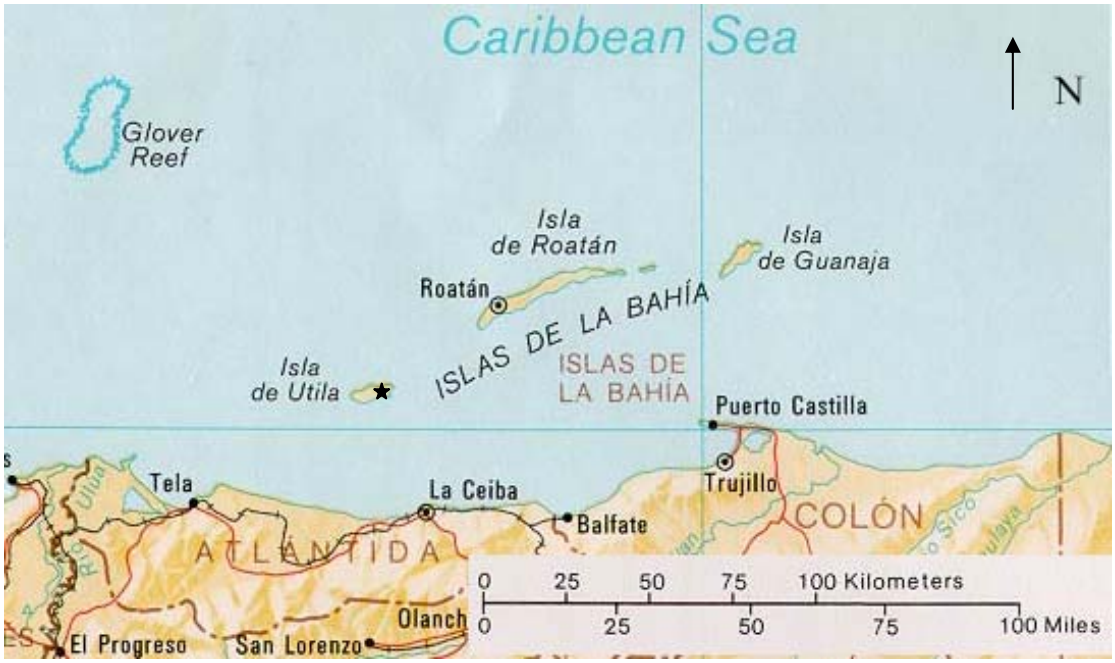

Figure 1. A map highlighting the location of Utila within the Bay Islands and in relation to the Honduran mainland, ★ depicts the location of Eastern Harbour.

The population of Utila in 1971 was 5599 (Davidson 1974), and today is 8500 (there is no reliable census) not including the visiting tourists (Interviewee 36). The main settlement of Utila is Eastern Harbour (figure 1), there are no other real settlements upon the main island, the only other areas of dense population are the cays, south west of Utila. The land type is mainly wetlands and swampland (figure 2); this has dictated the areas for settlement upon Utila.

The economy of Utila is based primarily around the dive industry; approximately 85% of its economy derives directly and indirectly from the dive industry (Interviewee 36). Before the onset of tourism Utila was a poor island with an economy based upon offshore work and fishing (Harborne et al., 2001). Tourism within the Bay Islands has been heavily pushes since the 1980's (Stonich 1998), resulting in a growing trend of cruise ships and backpackers travelling to the Bay Islands (Stonnich 1998). Between 1987-1991 the tourist industry within the Bay Islands grew at approximately fifteen percent annually, far exceeding global trends (Fielding 2000, cited in Harborne et al., 2001). Based upon 1998 data, dive tourism within the Bay Islands generates $11million annually (Harborne et al., 2001), but according to Luxner (2007) Roatàn (a neighbouring island, figure 1) generated over US$180 million in 2006 from the tourist industry. The tourist industry boomed upon Utila in the late 1970's early 1980's; in 1971 there was only one hotel on the island, Hotel Jimenez (Davidson, 1974). Today there are more than 30 hotels and 12 dive shops (Interviewee 36). The rapid birth of the dive industry and the intense competition between the dive companies, coupled with the low level of infrastructure and services in place upon Utila at the time (Interviewee 4), it has become a haven for the low-budget traveller, the backpacker. These tourists' demands for accommodation, food and entertainment have caused significant infrastructural developments upon Utila. In conjunction with property development for holiday and retirement homes that that is occurring upon the island, the population is rapidly growing and the demand for housing and space is increasing. The result of these demands has been deforestation and urban encroachment into mangrove forests to supply land for development and provide housing for the population of the island. With the growth of the dive industry development of the islands infrastructure and urban areas (Eastern Harbour) has proliferated, and the economy of Utila has

risen tremendously, increasing the standards of living for many of its inhabitants (Interviewee 36). The Bay Islands as a whole have had significant economic growth, although Guanaja has been in a depressed state since hurricane Mitch hit in 1998 (Harborne et al., 2001). Utila is the fifth most affluent municipalities of Honduras (Interviewee 9), due to the growth of dive tourism.

Utila's rapid development and lack of urban planning is causing environmental degradation as well as tensions between various stakeholders, due to the actions and behaviours of other stakeholders upon this small island. The increasing standards of living and opportunity of affluence accumulation is attracting the migration of large numbers of people to the island. Competition between these individuals is dividing groups of stakeholders and stakeholder groups. In addition to an increasing migration of mainland Hondurans to the island, tourist-residents are also increasing, thus population pressures upon infrastructure and basic services such as freshwater are increasingly under pressure. All of the stakeholders are somehow reliant upon the coral reef health to ensure their economic and social sustainability, but current activities are threatening its very existence. This aim of this research is to identify key areas of concern of the stakeholder groups and provide recommendations to aid in sustaining the economic, social and environmental elements of Utila.

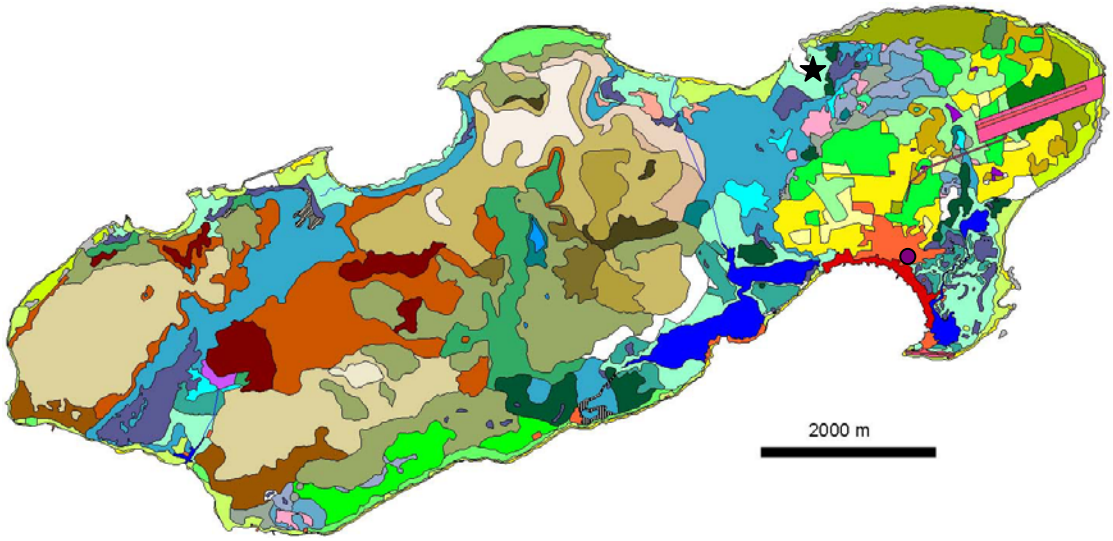

Figure 2. A map showing the various vegetation and land use types of Utila, map and legend were provided by courtesy of the Iguana Station. ●Depicts the approximate location of Camponado, ★depicts the approximate location of Iron Bound.

Legend for vegetation and land use map:

3.0 Materials and methods

Pre-knowledge of Utila, and the various problems associated with the relationships between stakeholder groups, and their interaction with the environment was derived from conversations with a scientist based on Utila. Greater theoretical knowledge was achieved via reviews of both social and natural science literature, these readings led to the identification of the key areas to be analysed to get an in-depth understanding of the various systems of Utila. From this it was determined that a multidisciplinary approach was required if all the facets were to be realised and understood. Qualitative and quantitative data would be required from both the natural and social science disciplines to gain a complete perspective.

In order to assess the current status of one of the key ecosystems on Utila, the mangrove forest, the current status of this ecosystem was investigated by performing a transect study. The environmental data consists of simple survey methods a long transects within a mangrove forest. The mangrove ecosystem was chosen due to the complex interactions it has with both the terrestrial and marine environments (Alongi, 2002), and therefore can act as an indicator to the health of more than just on ecosystem. Two sampling sites were specifically based on their varying level of anthropogenic activity. Iron Bound on the north shore of Utila (figure 2), is an isolated part of the island and therefore has minimal amounts of disturbance from human activities. Camponado, located in the outskirts of Eastern Harbour (figure 2), is an area of high human activity with significant levels of urban development occurring. At each site six different transects were established and sampling at five equidistant points along the transects took place. At each of the five points a one-meter square quadrat was placed and the number of pneumatophore roots and seedlings were counted, pH was also recorded. These three factors were chosen as they best represent the overall stability of the mangrove system and the ability to perform ecosystem services (Young and Harvey, 1996), the capacity to rejuvenate, and indicate the level of effluents and detergents discharged into the area (Mandura, 1997). Transects were established based upon accessibility and reflecting the conditions of the area, random selection could have led to skewed results and a true depiction of the area may not have been achieved. Due to the greater degree of variance in tree species at the Iron Bound, which was the site first sampled, transect number 4 is different from all the others. Rather than being between two black mangrove trees, it is between a black mangrove and a red mangrove. Data analysis consisted of a Mann-Whitney U-test; in addition standard error was calculated and added to the graphical presentations of the data (Fowler et al., 2003).

A problem facing all Caribbean reefs is a phase shift from coral dominated reefs to an increasing propensity of algal domination (Idjadi et al., 2006). According to Gardner et al., (2003) the rate of coral decline to the Central American Mesoamerican barrier reef system are increasing, thus accelerating the shift from coral to algal dominated reefs. An El Nino event in 1997-98 in addition to global warming, caused a large-scale coral bleaching event worldwide, in neighbouring Belize a coral population was decimated and other coral species severely affected (Aronson et al., 2000). The reefs surrounding Utila will have been affected by these events, and the destructive effects of Hurricane Mitch, which struck in 1998 (Interviewee 29, Harborne et al., 2001).A significant part of the link between these three environments is the energy flows through fish population dynamics. Fish species important both to commercial fisheries and the health of the coral reef system utilise the mangroves for spawning grounds, nursery areas and hunting grounds (Zorini et al., 2004). Reef fish populations with a healthy mangrove forest within close proximity can have double the biomass in comparison to reef fish dependent upon distant mangroves or solely

on the reef for hunting, spawning and nursery grounds (Mumby, 2006). Due to the continued over-exploitation of fish stocks through over-fishing and destruction of mangroves (via urban encroachment), fish stocks have noticeably declined (Interviewee 20, Interviewee 16). The combination of these anthropogenic influences of eutrophication, sedimentation, mangrove deforestation and fish stock decimation, further contribute to the phase shift from a coral dominated reef to an algal dominated reef. Due to resource availability it was not possible to perform a reef health assessment inferences, thus inferences to reef health are made from the study of mangrove health due their intrinsic linkages.

Another focal point of the study was upon social dynamics and thus a stakeholder analysis was deemed to be the most appropriate form of investigation to gain an understanding of the dynamics between stakeholders and the environment on Utila. The stakeholders were identified through literature reviews pertaining to the Bay Island and similar case studies in other regions. The study is framed as a single case study (Yin, 2003:13), using triangulation of the various research methodologies to increase the comprehensiveness and understanding of the case (Yin, 2003:97). A semi-structured interview for key stakeholders was constructed (appendix 1) (Kvale, 1996:124; Mikkelson, 2005:171-2) with the aim of defining important themes and relationships of the individual and as a representative of a stakeholder group. Causal loop diagrams (CLD's) were utilised to identify key actions and drivers within the stakeholder interactions, and to highlight key problem areas (Haraldsson, 2004).

A total of thirty-six individuals were willing to be interviewed, their personal details are described in appendix 1. Interviews were conducted between 22nd January and 28th February 2007, in a quiet room where the interviewee felt most comfortable, either at their place of work or in their home, where the interview could be conducted without interruption. Interview length ranged from 45 minutes to 150 minutes, this was very much dependent upon the interviewee. Only 10 of the 36 interviews were performed in people's homes, the remainder were conducted at the interviewee's place of work. To set the scene of the interview, I introduced myself and explained the purpose of the interview to the interviewee, and then a time and day for the interview would be decided. Before the interview commence a reiteration of the purpose of the interview was given, in addition to a briefing and a debriefing at the start and completion of the interview, respectively (Kvale, 1996:128). The interviewees were only comfortable with the situation if I did not record the dialogue of the interview. The majority of the interviewees desired to be anonymous, to ensure they could speak the truth but not be held accountable by other stakeholders who may read this document. Therefore note taking using key words and short sentences were used to document the interview. In order to ensure salient points were documented correctly, qualification by using prompts, probes and checks (Mikkelson, 2005:177) were routinely used. As a result of the note taking, I would read through the notes and document the interview directly after the interview concluded to ensure as complete documentation of the interview as possible. Problems with such interviews are answer construction and directing the interview, this was minimised by the broad scope of the questions.

Adaptations of the interview were needed on arrival to Utila as a result of accessibility to certain stakeholder groups and individuals. Many of the developers of the island lived in remote places or not even on the island and thus contact was difficult. Thus I was not able to interview any of these people and therefore had to rely upon the opinions and perceptions of them by the other stakeholders. Particular individuals were also difficult to track down even when interview times had been prearranged between ourselves, in some instances several days were wasted by turning up to

interviews where the interviewee did not appear. The mainland Honduran community was another stakeholder group where accessibility was a problem. Firstly a translator was needed to communicate the questions and answers between six interviewees and myself. Secondly due to past experiences of a previous research investigation asking insensitive questions, the interview changed and focused around this stakeholder group, to gain a greater insight into their lives. Once the interviews commenced and my translator built up a good rapport with the interviewees they became very responsive. Initially there was a three-way dialogue, but this stifled the dialogue and frustrated the interviewee, therefore the translator and interviewee had a continuous dialogue throughout the interview. I was able to follow the basic concept of the dialogue and was able to clarify point during and after the interview. Translation of the interview immediately proceeded the interviews to ensure the interview was thoroughly documented.

A survey was constructed for tourists (appendix 3) an important stakeholder group, who were unwilling to give up significant amounts of time. A survey was devised to take a maximum of two minutes but still be able to determine the predominant type of tourist coming to Utila and the important criteria behind their visit. The purpose of the survey was also to discover the real demands of the tourist and crucial elements to why they visit Utila. The surveys were conducted over three days; I was given permission to conduct my surveys in a restaurant (days) and a bar (early evening). This was decided as the best method to remove bias from the survey as all types of tourists visit the restaurant and bar where the surveys were conducted. A major problem with this stakeholder group is the possibility of not caring about their answers and not taking the survey seriously, therefore affecting the results.

There are limitations with this methodology; a major factor is the environmental data, which offers only a ‘snapshot’ of the condition of the mangrove forest for that day. The data offers no trend in the condition of mangrove health, whether it is deteriorating or improving, a time series data set would have been more useful, but was not achievable due to limited time and resources. Interview reliability is subjective, interpretation could be based upon preconceptions, the use of open-ended questions should reduce this situation. Moreover, certain questions could be answered completely different depending on the mood of the person and events that cold have occurred through the day in regards to a certain person or stakeholder group. In addition not all stakeholder groups were interviewed due to accessibility, and therefore could not represent themselves within the study, this could lead to a bias for or against these stakeholders. These factors were compensated for by the large interview group, therefore the repetition of specific actors and actions by different interviewees increased the reliability of the results.

4.0 Results

4.1 Environmental data for mangroves

At Iron Bound, the greatest number of pneumatophores counted was 555 and the minimum was 134. Variation of pneumatophores within quadrats was much greater in comparison to Camponado, as seen by the error bars (figure 3). The range of pneumatophores at Camponado was 294 and 0 (zero). Although visibly there are marked differences between the sample sites, they both follow the same trend of having the greatest pneumatophore density at the base of the trees surveyed and decreasing with distance from the base tree. The density of pneumatophores between the two sites are significantly different (Mann-Whitney U-test, p=0.05) and may indicate that something other than natural variation has caused the decrease in pneumatophore density.

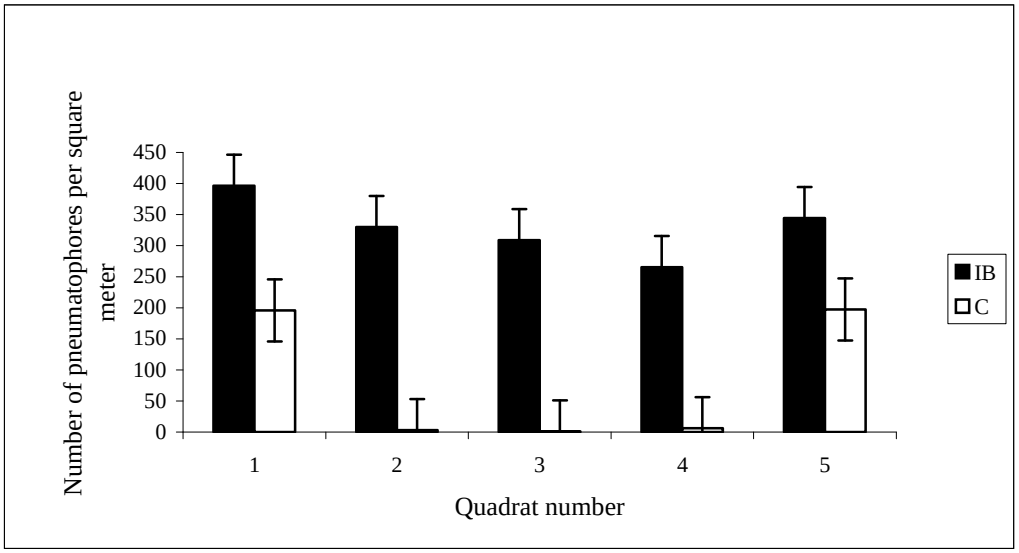

Figure 3. Graphical representation of the mean number of pneumatophores counted across transects at each sample site, error bars show the standard error of the samples. (IB = Iron Bound, C = Camponado)

The pH at both sites show variation within quadrats and between quadrats (figure 4), at Iron Bound the maximum pH recorded was, 7.3 and the minimum 6.4, in contrast maximum and minimum readings at Camponado were, 9.2 and 7.2 respectively. The two samples are significantly different (Mann-Whitney U-test, p=0.05), thus the increased pH at Camponado is not natural variation and can be attributed to exogenous factors.

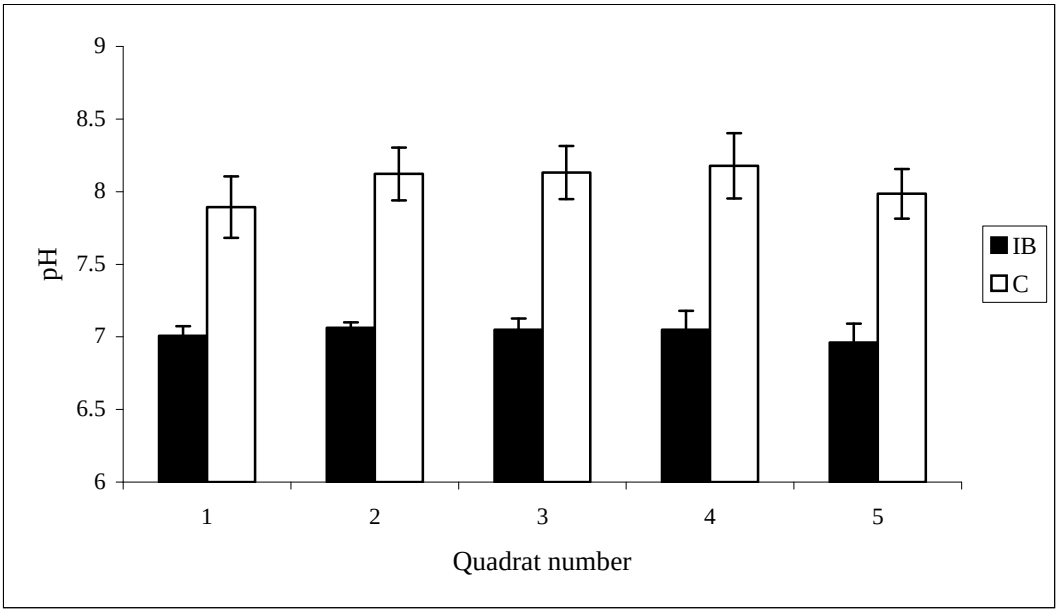

Figure 4. Graphical representation of the mean pH measured across transects at each sample site, error bars show the standard error of the samples. (IB = Iron Bound, C = Camponado).

Seedling number between the two sites, Iron Bound and Camponado (figure 5), exhibit much less variation in comparison to pneumatophore density (figure 3), and in the case of the fifth quadrat have almost identical means (IB=15.7, C=15.5). Iron Bound shows a much greater variation within quadrats and has no relationship between the number of seedlings and the position along the transect, the maximum number of seedlings observed within a square meter was, 97 and the minimum was 1. Conversely, the samples from Camponado are more homogeneous and follow the same trend of the pneumatophores (figure 3), peaking at the base of the transect trees. The range of seedlings counted within a quadrat at the Camponado site was 0(zero)-47. Statistical tests (Mann-Whitney U-test, p=0.05) revealed that there was no significant difference between the two sites.

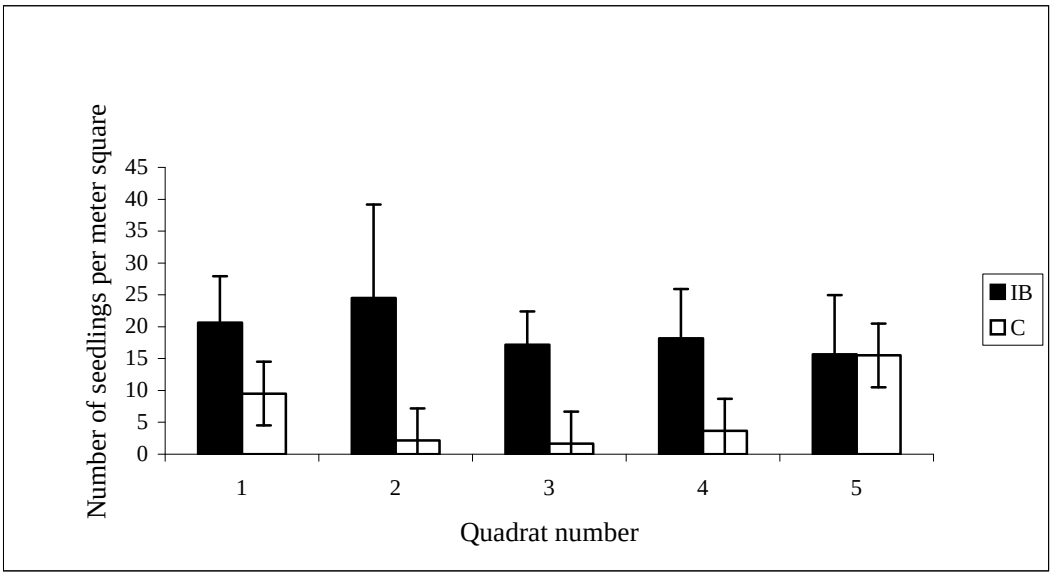

Figure 5. Graphical representation of the mean number of seedlings counted across transects at each sample site, error bars show the standard error of the samples. (IB = Iron Bound, C = Camponado).

4.2 Stakeholder data

The place of origin of each of the stakeholders is represented in figure 6; the most common place of origin for the stakeholders was Utila, comprising 33% of the interviewee sample. Of the remaining sample group 22% originated from Mainland Hondurans and the remaining 45% of the interview group are from countries other than Honduras the majority (19%) are from Europe.

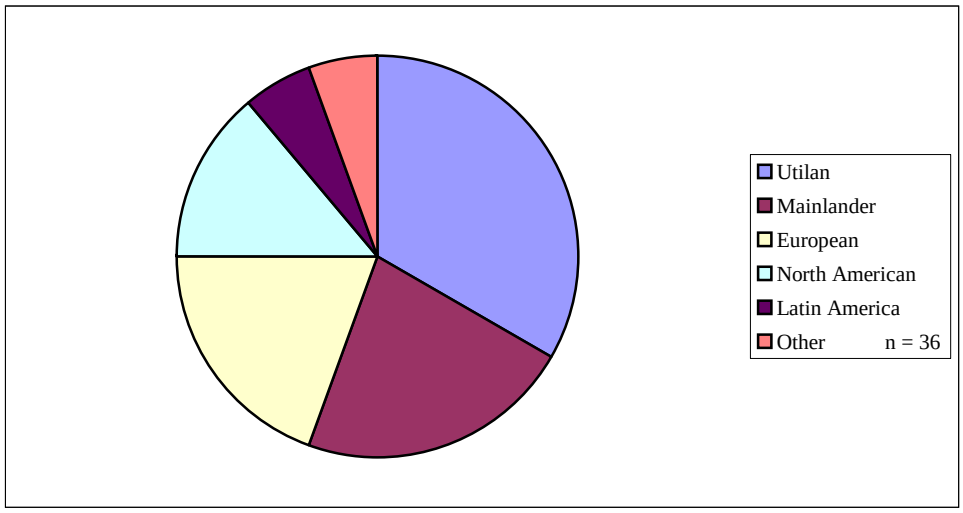

Figure 6. A pie chart presenting the original place of birth for the various interviewees, the term mainlander represents Honduran citizens who have moved from the mainland to the island of Utila.

The period of residence of the various stakeholders on Utila is presented in figure 7; an overwhelming majority of the stakeholders (39%) have resided for less than five years upon Utila. A minor proportion of the stakeholders have inhabited Utila for five to ten years, whilst the spread of inhabitation is evenly spread between the remaining time frames.

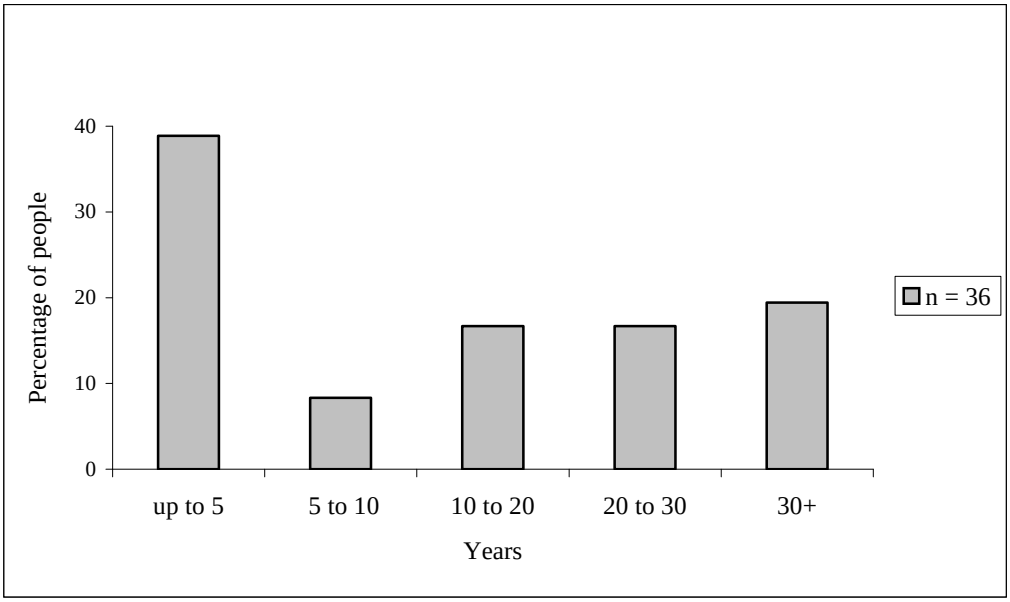

Figure 7. A histogram displaying how long the various stakeholders have dwelled upon Utila.

The employment sector of each stakeholder was identified during the interview and is presented in figure 8. A total of 31% of the interviewees are directly involved with the dive industry, and a further 30% were involved with the associated services of the dive industry; the hotel, restaurant/bar and retail industries. An important and growing sector on Utila is real estate; 13% of the stakeholders were involved within this industry.

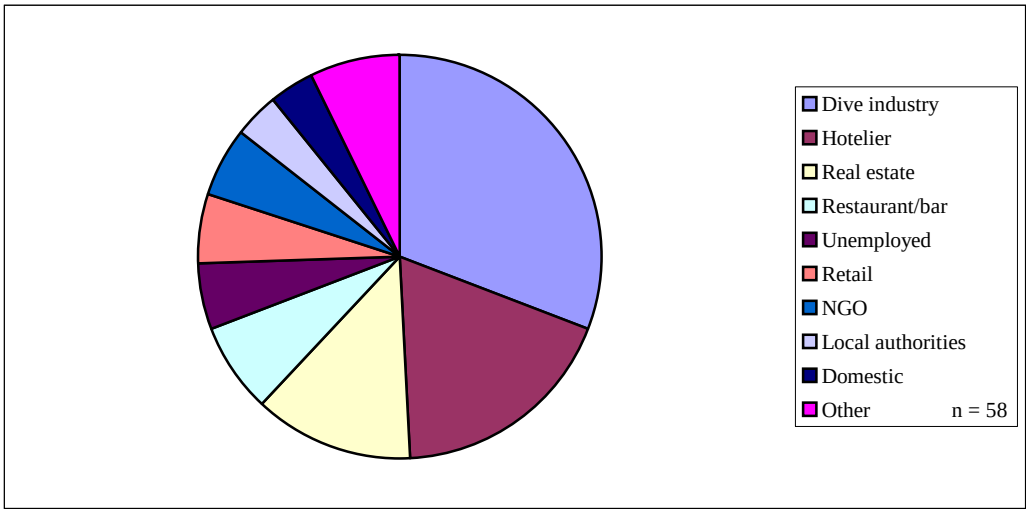

Figure 8. A pie chart portraying the key employment sectors for the stakeholders upon the island, some stakeholders are involved in more than one sector, therefore n=58, not n=36.

4.3 Survey data

The deciding factors for the tourists coming to Utila are presented in figure 9, some giving more than one answer (giving a sample size 112). An overwhelming majority of the sample group visited Utila to engage in some form of diving activity, 50% of the sample, were involved with dive courses, a further 16% travelled to Utila to fun dive. In addition 20% of the sample arrived on Utila to partake in non-diving but marine based activities, the whaleshark is becoming an increasing attraction (Interviewee 5).

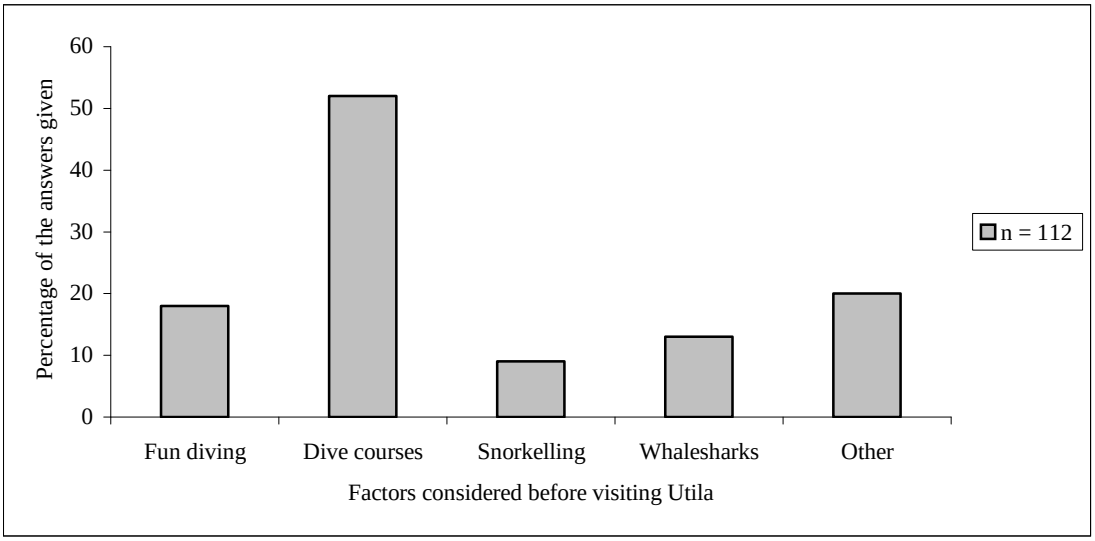

Figure 9. A histogram depicting the factors that the survey pool considered before visiting Utila.

Figure 10, depicts which factor each individual deemed to be most important when choosing Utila as a place to holiday, only one answer was permissible per person. The most important factor to the survey pool was the price of diving and dive lessons (44%), living cost were also reasonably important (23%). The most noticeable part of this survey result is that less than 5% of the survey pool decided upon their visit based on fish populations and coral coverage on the reef.

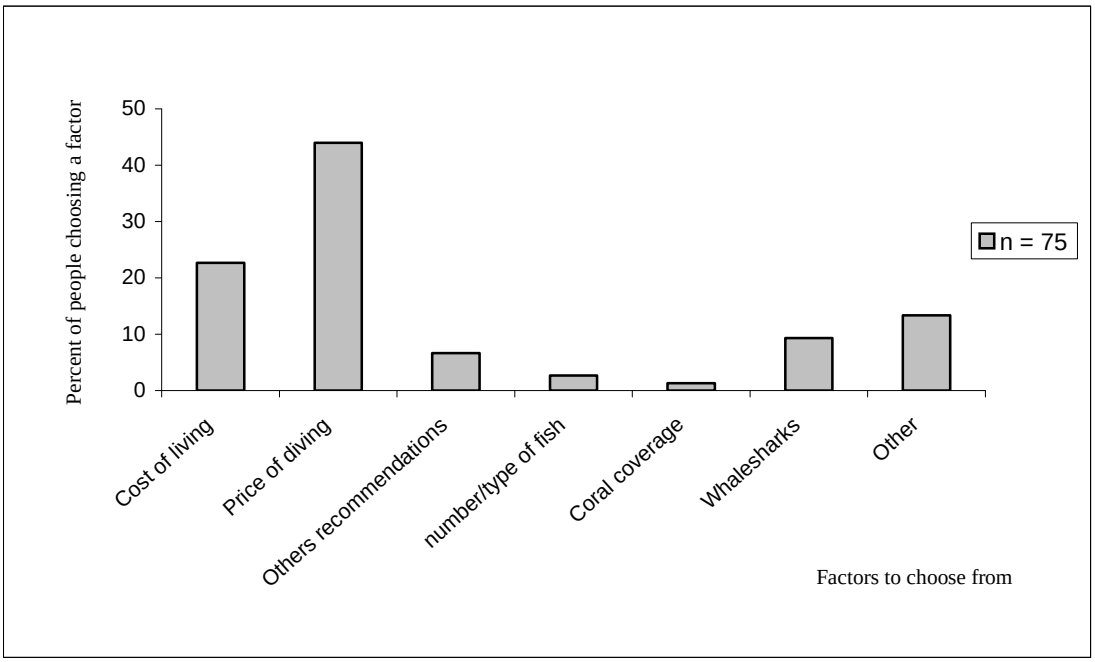

Figure 10. A histogram showing the most important factors for individuals when considering visiting Utila.

Figure 11 reveals that the majority of the people visiting Utila are there for two weeks or less (57%). This corresponds with the usual holiday of a working professional, but only 8% of the sample group were travelling for a period of two weeks or less. The majority of the people visiting Utila will be travelling for over six months (67%), revealing the type of tourist mainly visiting Utila, backpackers.

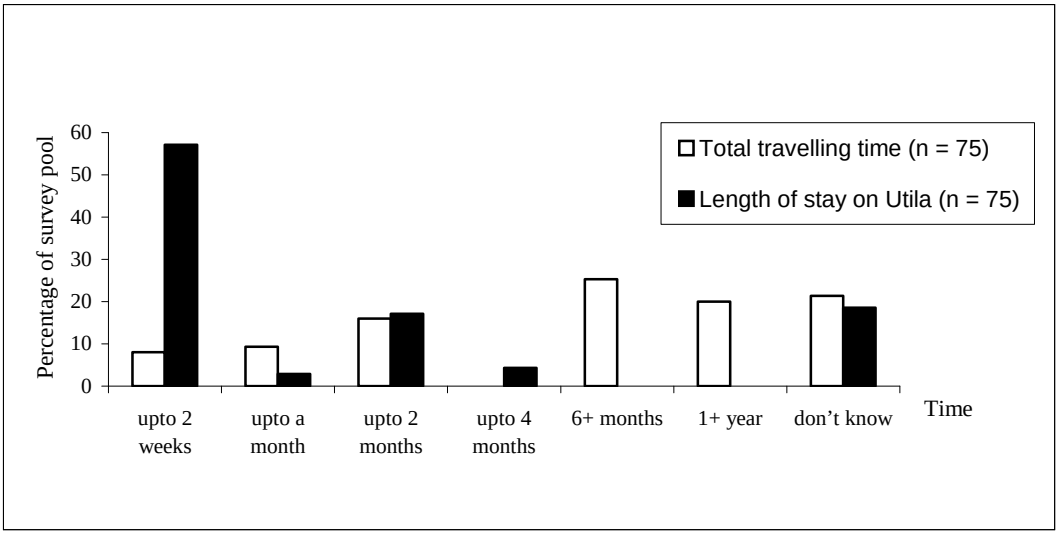

Figure 11. A histogram showing the various travel patterns of the survey pool and how much time they intend to stay on Utila.

Figure 12 reveals that 61% of the people surveyed would return if the price of diving were to increase. An important note is that many people commented on this question, and were of the opinion that the diving is very cheap so a small raise in cost would be acceptable. Approximately one third of the survey group would not return if the price of diving increased.

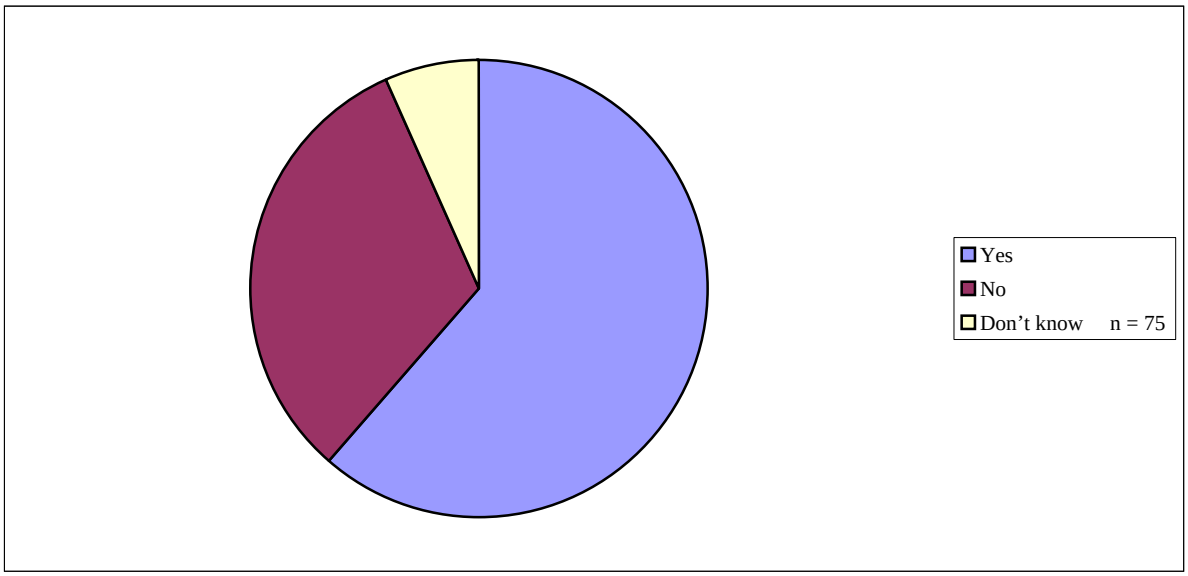

Figure 12. A pie chart showing the percentage of the survey group that would return to Utila to dive, if the price of the diving increased.

An important factor concerning the future visitation of tourists to Utila is the reef health, 21% of the tourists surveyed would return if the condition of the reef decline (figure 13). More significantly 69% of the survey pool would not return if the health of the reef were to decline.

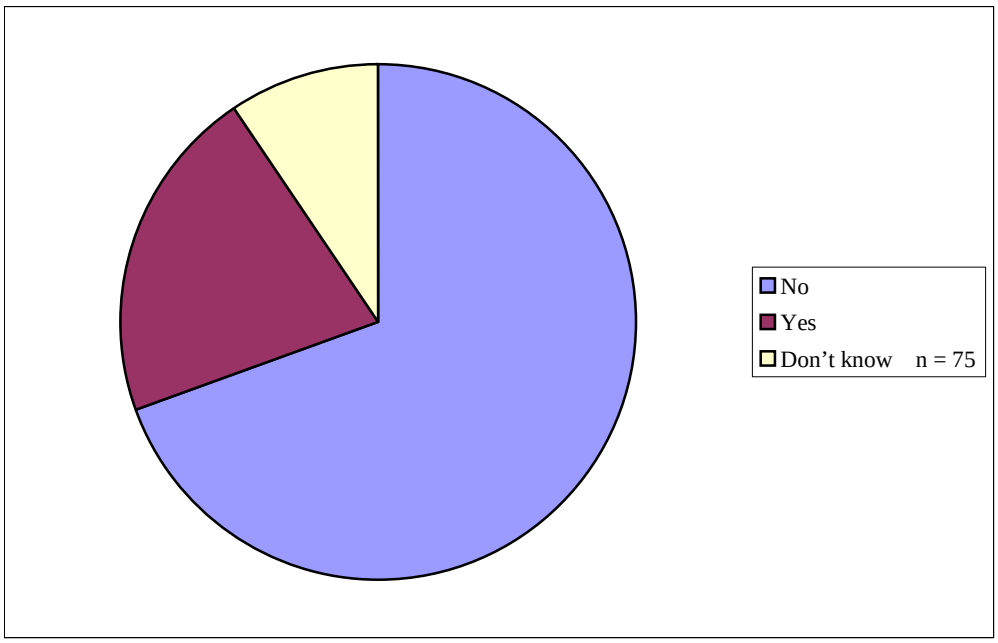

Figure 13. A pie chart displaying the responses of the survey group to whether they would return if the reef condition declined.

Although the survey group did not decide upon their visit upon the condition of the reef, an overwhelming majority perceived the condition of the reef to be good to average (53%), (figure 14). Whilst a quarter of the survey group perceived the reef condition to be good, only 9% determined the reef to be in poor condition.

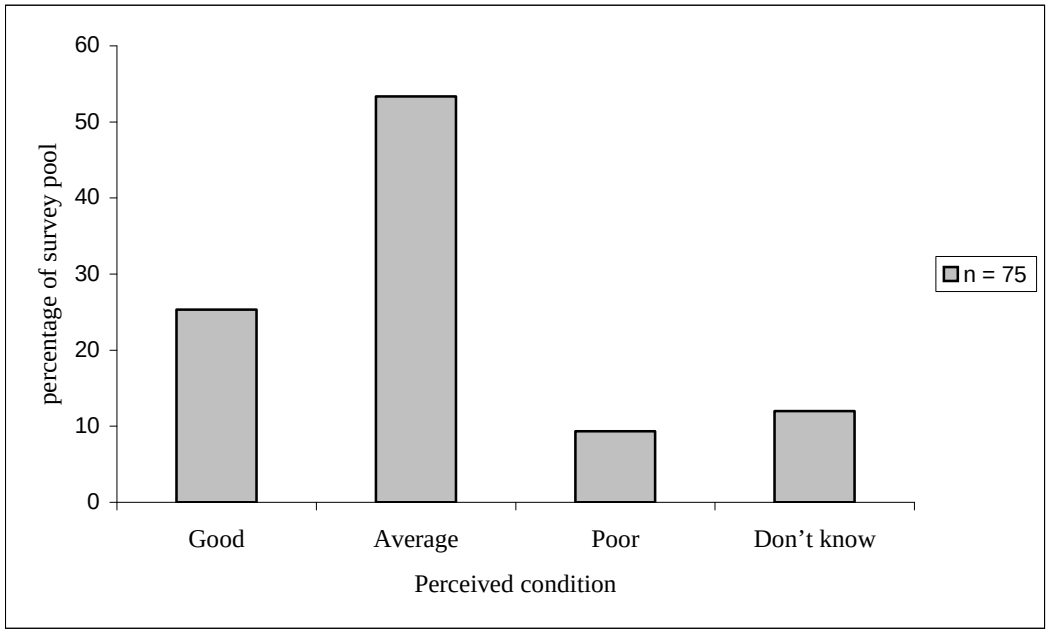

Figure 14. A histogram portraying how the group of tourists surveyed perceived the condition of the reef around Utila.

5.0 Analysis

5.1 Environmental Analysis

Coral reefs have become an integral part of the islands economy, due to its reliance upon the dive industry. Through the proliferation of the dive industry and the increased tourists visiting the island over the past twenty years, impacts to both the marine and terrestrial environments have increased. Natural phenomena, which are causing a phase shift on the coral reefs and affecting mangrove distribution (Aronson et al., 2000; Bacon 1994; Gardner et al., 2003;) are the anthropogenic affects associated to the increased development and population of Utila (Cormier-Salem, 1999; Holguin et al., 2006) (figure 15).

The link between the mangrove forest and the reef has been established (Alongi, 2002), thus the reduction in the capacity of mangrove ecosystem services has important implication to the reef system (figure 15). The key basic determinants in assessing the health and future health of a mangrove forest stand are the pneumatophore root density, the seedling number and the pH. A limitation of the method employed as the data does not reveal any trends or information regarding past or future conditions of the mangrove areas. These factors have crucial thresholds and thus are useful indicators to the overall forest health, becoming most useful when monitored over successive years to study trends (Holguin et al., 2006). The main impact to the reef is through, eutrophication, sedimentation, and mangrove deforestation (Harborne et al., 2001) (figure 15). Eutrophication is linked to the rising population of Utila and the lack of sewage and grey water treatment; these effluents are discharged straight into the surrounding waters (Stonich, 1998). Sediment runoff is increasing through the increased development and clear cutting of vegetation to prepare areas for construction. Property development is concentrated to coastal areas of Utila (Interviewee 3), and the open drain system facilitates the movement of sediment from the land to the sea (Interviewee 17). The increased nutrients and sediment in the water contribute to coral bleaching and accelerate algal growth decreasing reef health (McManus and Polsenberg, 2004) (figure 15).

5.1.1 Pneumatophore density

The density of pneumatophores is an important concept within the mangrove ecosystem; they determine the soil characteristics of an area, having an important role in trapping and stabilising sediments (Young and Harvey, 1996), with an important role in decreasing coastal erosion (Spenceley, 1977). Stabilised sediments produce a benthos for floral settlement and faunal activity, by increasing the abundance of various fauna, especially crabs and worms nutrient recycling and retention within the ecosystem is increased. The densities of pneumatophore roots at Iron Bound were significantly higher that the densities found at Camponado (figure 3) (Mann-Whitney U-test, $p=0.05$). The increased density of pneumatophore roots contributed to greater sediment stability (personal observations). Pneumatophore density is highly dependent upon the number of trees present within an area. According to Mandura (1997), prolonged exposure of mangrove areas to sewage effluents can promote algal growth that smothers pneumatophores, preventing gaseous exchange, resulting in stunted growth or death, and a reduction in pneumatophore density.

The reduced stability of sediments as a result of decreased pneumatophore density allows for sediment transportation with tidal flows, increasing the sedimentation which cause coral

bleaching (Harborne et al., 2001 McManus et al., 2004). The loss of sediments results in a reduction in habitat for the associated fauna, especially crustacea. Crab populations are a critical link within the rapid recycling of nutrients within the mangrove ecosystem and also form an important link within the many associated food chains of both the terrestrial and marine environments (Jimenez et al., 1985).

5.1.2 pH

The pH of the pore water of mangrove sediments is important as pH can affect the ability of mangroves to uptake water and nutrient (Saenger, 2001:5). The pore water at Iron Bound fluctuated around pH 7 (neutral), whilst the pore water pH at Camponado ranged from 7.2 to 9.2, proving to be significantly different (Mann-Whitney U-test, p=0.05) (figure 4). The cause for these alkaline conditions can be attributed to the discharge of detergents within the grey water coming from the populations encroaching into these mangrove areas. The pollutants from the grey water may have accumulated over a long period of time, thus increasing the pH. Resulting from the presence of the contaminants the ability of mangroves to produce new pneumatophore roots are affected, thus reducing their density and stunt the growth of individual trees (Mandura, 1997). The health of mangroves, seagrass beds and coral reefs can be heavily impacted by the release of municipal sewage, thus risking social (disease), economic (reef health) and environmental (reef health) sustainability of stakeholders inhabiting and utilising these resources for economic purposes (Mohammed, 2002).

5.1.3 Seedling number

Seedlings are obviously important for rejuvenation of an area; therefore the fewer seedlings present the lower the capacity to rejuvenate. The local sediment conditions and tidal conditions are important factors in determining seedling settlement and dispersal (Minchinton, 2001). The local sediment conditions are much more influential over the establishment of seedlings, stable sediments are important for their faunal and nutrient assemblages (Minchinton, 2001). The seedling numbers between the two sample site sites were not significantly different (figure 5) (Mann-Whitney U-test, p=0.05), but visibly there appears to be a lower frequency of seedlings at Camponado in comparison to Iron Bound.

Seedlings are an important food source to some species of crab (Nordhaus et al., 2006) and therefore by reducing the initial output of seedlings seedling predation will become a more important factor as this food source becomes scarce (Clarke and Kerrigan, 2002). Further reducing the capacity of the mangrove forest rejuvenation, but also affects the crab population, which is an important nutrient recycler and forms an important part of the mangrove food chain (Nordhaus et al., 2006). Crabs also perform the important role of bioturbidation, which plays an important role within seedling recruitment (Jimenez et al., 1985 Minchinton, 2001); therefore crabs have important roles within mangrove forest health and therefore have implications to reef health.

The reduction of mangrove health has implications to all the spheres of sustainability (figure 15). A dense stand of mangrove forest establishes a self-regenerating coast and coastline protection (Pons and Fiselier, 1991), offering protection against hurricanes, and providing ecosystem services that will promote, economic, environmental and social sustainability (Christie et al., 2005). These services are vital for the functioning of the coral reef system (Alongi, 2002) and important in regulating fish populations (Mumby, 2006). These two factors are crucial in maintaining the dive

industry and to allow for continued fishing in the area, thus affecting the socio-economic sustainability of Utila. The change in coral reef health is already noticeable to some of those who rely upon it (Interviewee 9; Interviewee 19; Interviewee 29), in addition the reduction of fish abundance is starting to cause concern (Interviewee 13; Interviewee 17; Interviewee 26). Fish populations are an important factor in the increasing algal dominance of the coral reefs, key species are losing their spawning, nursery and hunting grounds, thus influencing the composition of fish upon the reef (Alongi, 2002). These affects of anthropogenic activities are being noticed now, but there various stakeholders worry about the long-term changes that will affect Utila (Interviewee 1; Interviewee 34).

5.2 Stakeholder Analysis

5.2.1 Utilian Community

This stakeholder group consists of eleven individuals that were born on the island. These people are primarily involved within the diving, real estate, hotel, bar and retail sectors of the island, this stakeholder group has directly benefited from the economic growth associated with the dive industry, for example the standard of living has significantly increased, especially compared to the Honduran mainland (Harborne et al., 2001). The themes that arose during the interviews with this stakeholder group, the most commonly discussed themes were increasing population of the island (64%) and the increase in tourism (dive) industry (55%).

During the discussion regarding the increasing population, it was noted that it has been caused by the migration primarily of mainland Hondurans and secondly by tourist residents (Interviewee 7; Interviewee 33), the effects of an increasing population are depicted in the CLD (figure 15). The mainland Hondurans come to the island in search of work, and undercut the wages demanded by the local Utilians (Interviewee 18). Whilst the tourist resident are involved in the tourist industry and property development or are retiring to the island (Interviewee 4). The majority of these people have come with a short-term mentality of making money, in doing so the economy of Utila has increased and improvements in infrastructure have been achieved (Interviewee 11; Interviewee 7). The increased level of tourism was also discussed; the dive industry initiated the economic growth of the island and improved the living standards for the people living here (Interviewee 29). In addition the employment opportunities that have arisen from associated businesses means that the males of the island no longer have to seek work offshore (Interviewee 29). The dive industry is increasingly monopolising the tourist market, via branching into supporting services and thus reducing the circulation of money throughout the stakeholder groups of Utila (Interviewee 18). The long-term affects of foreign investments are now being realised through economic disparities and tensions between stakeholder groups (figure 15) were insinuated (Interviewee 8; Interviewee 27), if these practices continue tensions between stakeholder groups will only increase.

5.2.2 Mainland community.

This stakeholder group consists of seven people born upon the mainland and now residing upon Utila. The most commonly discussed topic from the ten that arose (appendix 4) was the increasing population of Utila (50%). This stakeholder group has a large impact upon the population dynamics of Utila, the majority of which move migrate permanently (Interviewee 30; Interviewee 15). In some instances this could mean an addition of eight people to Utila, the parents

and six children (Interviewee 28). This group is attracted by the perception and of a better life, employment opportunities and higher wages (Interviewee 6, Interviewee 14). The long-term impact of this migration is an increasing pressure is placed upon the infrastructure, services and land of Utila (Interviewee 6). Water is already becoming a scarce resource upon the island especially within Camponado; this area receives running water three to four times per week (Interviewee 15). This has reduced the level of sanitation within the area, coupled with the high population density there is the potential of disease outbreak within the near future (Interviewee 35; Mohammed 2005). Development associated with the population increase, has caused a reduction to mangrove forest coverage (Interviewee 28), this has the potential to lead to deterioration of coral reef conditions in the longer-term (figure 15).

5.2.3 Tourist Residents

This stakeholder group consists of non-Hondurans residing upon Utila; fifteen of the people interviewed represent this group. The majority of these stakeholders are directly involved within the dive and real estate industries. A total of twelve themes arose during the interviews. The main themes that were discussed were the increased development (60%) and also the decline in marine life in the coastal waters of Utila (60%). The development of Utila has brought many positive attributes; it has boosted the economy and provides jobs for people living on the island (Interviewee 10), and has brought another industry to the island, which has allowed greater investment into infrastructure, they are providing services for the community (Interviewee 26). The problem with a lot this development is that it is a short-term gain, with little or no consideration to the environment the long-term future of Utila is being put at risk (Interviewee 24). The development is a double-edged sword, a lot of money has been brought to Utila and the community has benefited but in the long term much of the development that has occurred could have serious impacts to the environment, especially the coral reefs (Interviewee 25). The majority of the developers adhere to the building codes and currently look responsible, but in five years time the effects of their development will be seen and the situation of Utila environments will not be good (Interviewee 34).

The decline in marine life is a very important factor for this stakeholder group; it is one of the main assets for the island, but also attracted many of these people to move to Utila (Interviewee 24) (figure 15). The decline in marine life can be attributed largely to the type of development that is occurring, and its impact upon key ecosystems such as mangrove forests (Interviewee 13) (figure 15). No environmental impact assessments are conducted, and the health of the marine system is suffering (Interviewee 13), from the addition eutrophication, sedimentation and other forms of pollution associated with construction and lack of waste management on an island where the population is increasing rapidly (Interviewee 34). The focus of short-term and gains to improve the local economy, has led to the long-term effects of environmental damage by unsustainable practices have been ignored. The reduction in marine life currently being observed could be an indicator to the future long-term deterioration of the whole reef system, with the implications to both the environmental and socio-economic sustainability of Utila.

5.2.4 Local Authorities

A stakeholder group consisting of two members from the Utilian community, voted into their position by the Utilian community. The nine topics were discussed during the interviews; the common themes were the noticeable increase in tourism (100%) and an increasing level of social conflicts between various stakeholders on the island (100%). The dive industry has been a very

important phenomenon for Utila, the negatives of what it has brought are far out-weighed by the positives (Interviewee 36). The financial benefits over the last 20-years for Utila from the dive industry are significant (figure 15); with people enjoying a higher standard of living (Interviewee 9). The dive industry needs to do more concerted efforts towards environmental protection (Interviewee 9). The authorities aim to increase their partnership with the local dive shops to aid in the conservation of the reef, as long term goal to improve the environmental situation (Interviewee 36).

Social conflicts are occurring on the island are mainly associated with the dive industry and the fishermen, but these problems are rare and often settled with limited trouble (Interviewee 36). There are also a few troubles with a few tourists who have anti-social behaviours and the increasing trend of drug use (Interviewee 9). The authorities are aware of some of the illegal activities occurring upon the island such as poaching, felling and infilling of mangroves and drugs. The largest problem they face is enforcement, and only recently has the economy of Utila been able to invest in vital infrastructure, and priority has been given to these projects. Future objectives to aid in controlling these activities will be increasing the number of guards upon the island. This will also serve to reduce crime rates upon the island, making it a more attractive place for tourists to visit (Interviewee 9). Moreover, hopefully mean that the seasonal fishing laws will now become adhered to and that important reef species such as lobster and grouper will not be in the restaurants all year around (Interviewee 9). It is important that we protect our reef system, to maintain economic growth of Utila, and ensure that diving remains the dominant income for the island (Interviewee 36).

5.2.5 Non-Government Organisations

There are three NGO's upon the island of Utila, The Iguana Station, Utila Centre for Marine Ecology (UCME) and The Whaleshark and Oceanic Research Centre (WSORC), There is an increasing level of community and outreach work to educate the people, especially the younger generations about the environment (Interviewee 32). The main themes of discussion were the increased development (67%) and the level of pollution (67%) on and around the island of Utila. Currently development is unrestricted and many areas can be bought and developed even if it is strictly illegal to do so (Interviewee 32). Most of the developers do not perform environmental impact assessments, with the clear cutting of forests particularly mangrove forests and the associated sedimentation the reefs are becoming hugely affected (Interviewee 19) (figure 15). During the raining season the sediment entering the sea via the open drains is extremely high, this is only adding to the transition from coral dominated reefs to algal dominated reefs (Interviewee 17). More environmentally sounds methods of building are required to minimise the impact to the reef and thus sustain the economy of Utila, without the reef Utila will have no attractions for tourists (Interviewee 19).

The pollution of the island is associated with the level of development upon the island and the increasing population (figure 15). Not all properties or even business premises have septic tanks, therefore human effluent drains straight into the sea, moreover, there is now grey water treatment thus water containing detergents and chemicals also drains straight into the sea, there is no wastewater collection or garbage management (Interviewee 17; Interviewee 32). The effect of this is eutrophication thus further enhancing the phase shift from coral to algal dominated reefs (Interviewee 19). This means that not only household waste but also human waste is decaying within a populated area, leaching pollutants into soil and out onto the reef, in addition to the

hygiene issue of living in such conditions (Interviewee 32). With an economy based upon natural resources, especially an ecosystem as sensitive as a coral reef, greater resource management and protection is needed if Utila is to rely upon tourism into the future (Interviewee 32) (figure 15). The developers are here to make short-term gains and act very irresponsibly towards the environment more must be done to ensure these people develop with the environment and the future of Utila in mind (Interviewee 19, Interviewee 32).

5.2.6 Dive industry

A stakeholder group consisting of Utilians and foreign nationals, whom are directly employed within the dive industry. Fourteen of the interviewees constitute this stakeholder group, during the interviews nine broad topics relating to changes on Utila were discussed. The themes iterated by this stakeholder group with most poignancy were, the decline in marine life (79%) and the increase in the development of Utila (71%). The decline in marine life is a crucial factor for this stakeholder group and they also believe for the island, they are the dominant employers and activity on the island (Interviewee 16, Interviewee 25) (figure 15). There is a noticeable decline in some keystone species, parrotfish, grouper, lobster and conch, (Interviewee 34, Interviewee 13, Mumby, 2006). Although a noticeable increase in the number of small damselfish upon the reef, a species promotes certain algal species growth (Interviewee 17). Over-fishing is seen to be the cause of decline in certain commercial species (Interviewee 29, Interviewee 20), and it is having a trophic cascade, predators of specific species are being removed and thus certain fish populations are actually increasing (Interviewee 10). The dive industry must do more to help conserve the resource that it and the island depend so heavily upon (Interviewee 21), without this resource the island will have very little. Action is not only needed within this sector but also the property development industry, the unsustainable practices they are currently utilising will have some of the greatest effects upon the reef in the future (Interviewee 5).

Development of luxury houses for retired and semi-retired foreign nationals is mainly concentrated in coastal regions (Interviewee 3). Other development has been triggered by the boom of the tourist trade and the number of tourists coming to Utila and their demands for services (Interviewee 1l), such as infrastructural improvements (Interviewee 10) (figure 15). Nothing is being done to stop the destruction of the island and its resources (Interviewee 1), making short-term profits through selling of land and businesses are prioritised (Interviewee 23). The development occurring by all people upon the island is done with very little environmental conscious, mangrove destruction, vegetation removal and lack of septic tank installation is has potential effects upon the reef system (Interviewee 20, Interviewee 21).

5.2.7 Real Estate Industry

A group of four people consisting of both Utilians and foreign nationals whom are involved with land and property sales on Utila. The most commonly addressed topic was the increased development of the island (100%). There is concern within this stakeholder group of the behaviour of the developers concerning land clearance and the destruction of mangroves (Interviewee 22). Development occurring is not only the luxury coastal apartments but also in Camponado, where there is a similar trend of mangrove destruction (Interviewee 35). All development projects are initiated through short-term benefits in mind, the long-term effects of mangrove deforestation are either ignored or unknown by these people, the level of environmental awareness is low (Interviewee 35, Interviewee 31). The effects of mangrove deforestation, the removal of rocks and

beach alteration for luxury property development are already visible in certain areas, coastal erosion is increasing significantly (Interviewee 22). Concerns are being raised over the effects of hurricanes due to the removal of the mangroves an important hurricane defence (Interviewee 35, Interviewee 22).

Development has also brought benefits to the island in the form of revenue (figure 15), especially now with the property sales tax that goes to the municipality, in addition large numbers of jobs are created through the development of the island (Interviewee 31). A problem that will face Utila in the future will be the strain upon its infrastructure, the roads, power system, sewage and garbage, but with greater investment from development these services can be provided and improved (Interviewee 31). This is an important point as the development, which is occurring in Camponado, where no form of sanitation is occurring and thus the risk of an outbreak of cholera or typhoid is increasing (Interviewee 22). Another strain on services deriving from the level of development is water. Water is becoming scarce, and with increased development allowing and encouraging more people to come to the island water will become a precious commodity within the near future (Interviewee 35).

5.2.8 Tourists

A total of 76 people we surveyed, the principle reasons for tourists to come to Utila, 80% come for activities orientated around the coral reefs, primarily diving (figure 9). Figure 10, depicts the most important factors the tourists considered before their visit, 67% of the people survey pool were concerned with the costs of Utila, the primary factor behind people coming to Utila is the price of dive courses and fun diving, secondary was the cost of living, thus driving the low-budget tourist industry (figure 15). Thus the tourists are highly concerned with cost whilst on their vacation, over 80% of the visitors are travelling for more than one month, whilst approximately 60% of the survey pool will remain on Utila for less than two weeks (figure 11). Thus the majority of the people coming to Utila are travelling for extensive periods of time and are therefore on a strict budget, thus the cost of services and activities is very important to these people. Although concerned with cost a large proportion of the people surveyed did say that they would return if the price of diving increased, (figure 12). Many comments were made about this on the survey forms, regarding how cheap the diving was and therefore if a small increase was implemented it would not matter so much, but a large increase would deter them. It is an important point to note, that this is not an increase in living costs, many of these people were staying in accommodation subsidised by the dive shops to encourage tourists to die with them rather than another company (Interviewee 27). Although the environmental factors did rate particularly highly in regard to the decision-making and important factors when deciding to come to Utila (figure 10), 70% of the people would not return if the condition of the reef decreased (figure 13). The survey pool deemed the condition of the reef to be average to good (figure 14), but when some of these people have never dived anywhere else before or have limited experience of diving, how do they know what a good, average or bad reef resembles?

A causal loop diagram (CLD) was constructed from the various facets of the environmental and stakeholder analyses (figure 15). The CLD serves to illustrate the major interactions that are occurring on Utila based upon the data collected. The CLD highlights four important facets of the dynamics of Utila, the dive industry, the tourists visiting Utila, the Utilian population and reef health. These four factors are crucial in the dynamics of Utila's socio-economic sustainability, whilst the first three factors limit reef health and have a large influence on the environmental

sustainability of Utila (figure 15). The interactions on Utila are much more complex than this CLD depicts, and there are many more factors not highlighted that are equally as important, such as the education and medical facilities of Utila, but these were outside of the scope for this paper. The dive industry is currently the most important industry on the island (Interviewee 36), this is highlighted by the CLD (figure 15), it is the main driver behind the economic growth of Utila, the development of other businesses and therefore job opportunities, leading to an increase in population via the emigration of mainland Hondurans and foreign labour. The number of tourists visiting Utila dictates the prevalence of the dive industry, also influences the population of Utila. The overall influence of the population increase is waste generation and increased infrastructural demands which ultimately leads to more development. Both of these influences negatively impact the environment, through urban encroachment, sedimentation, eutrophication and solid waste accumulation. The net result is a decrease in mangrove health and most importantly for Utila reduced reef health, the reef health drives the socio-economic elements of sustainability on Utila. The reef attracts tourists and also the real estate market; both of these industries increase the economy of Utila and allow for the investment into infrastructure to improve the living standards of the Utilian population. Although the improvement in infrastructure improves the standard of living, ultimately further development degrades the environment and affects the standard of living in the longer term through increased social tensions and the attraction of more immigrants to place further pressure and demands upon the infrastructure and the environmental resources. The aim of the CLD is to show how the socio-economic elements of Utila reinforce themselves but have a unidirectional flow regarding the environment, and that is deterioration. The deterioration of these resources inevitably affects the socio-economic elements of sustainability, but the time-scale for this is difficult to predict, although signs are already be notices (Interviewee 13; Interviewee 19).

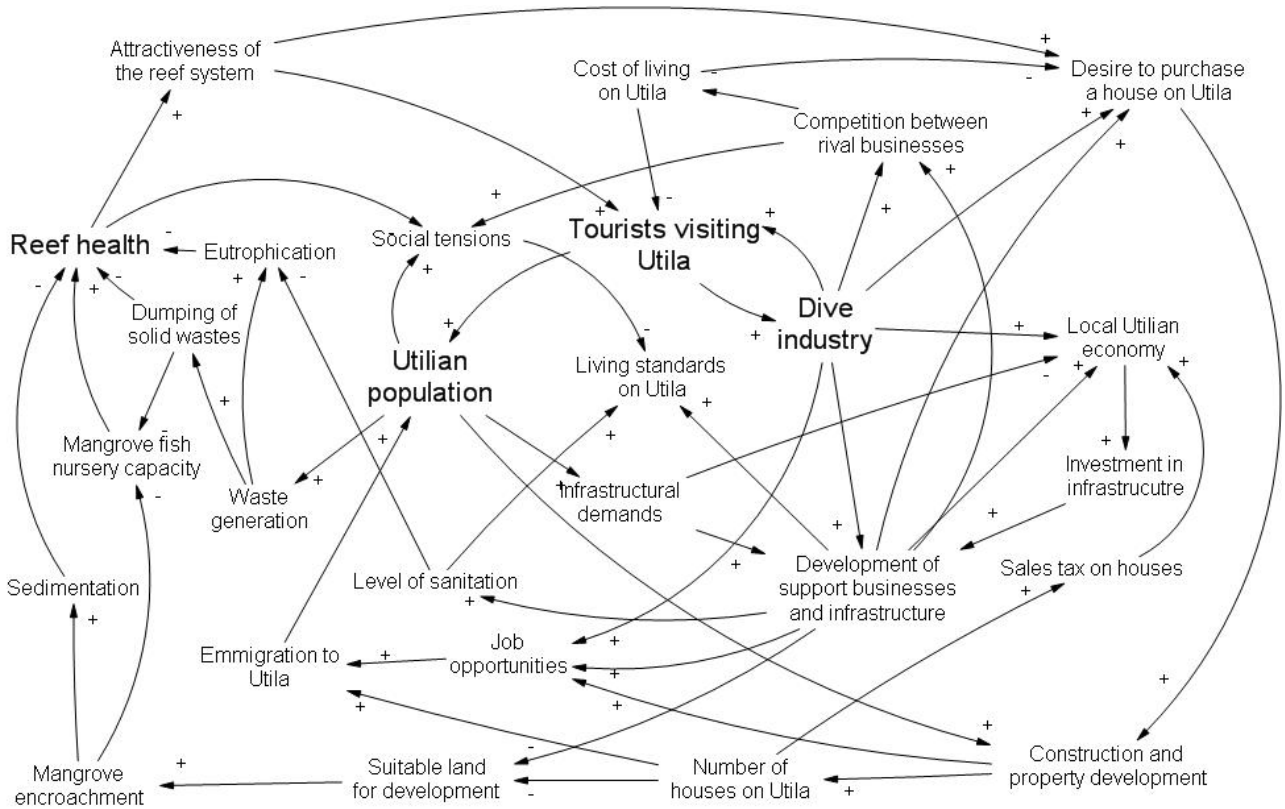

Figure 15. A causal loop diagram depicting stakeholder and environment interaction on Utila, a simplified version.

6.0 Discussion

6.1 The Environmental Sphere

There is both quantitative (figures 3-5) and qualitative (stakeholder analysis) evidence of environmental degradation occurring on Utila, which is systematically and detrimentally affecting the health of the mangrove forests and coral reefs associated with the island. Although the environmental data shows that the mangroves within Camponado have been affected, the results do not show a trend in deterioration or if in fact the situation is improving. With increasing pressures from urban encroachment and other anthropogenic activities it is assumed that the conditions will deteriorate further over time. The deterioration of such an important ecosystem as mangroves has profound affects upon surrounding ecosystems and overall biodiversity of the area. Destruction to the mangrove forests is becoming increasingly common (Interviewee 22), the degradation of mangroves can lead to the loss of biodiversity, an important factor in a comparatively species poor environment which relies upon a limited number of species to perform it ecosystem services (Alongi, 2002).

The effects to the reef from unsustainable activities and behaviours of the stakeholders are becoming increasingly evident by the decline in marine life and coral cover (Interviewee 17; Interviewee19). Every single person who lives or visits Utila is responsible for polluting its environment, through sewage and grey water discharge, and municipal waste production, although the level of impact may vary (figure 15). Eutrophication of the coastal waters is caused by the discharge of raw sewage directly into the sea or via the mangrove swamps. Eutrophication of the surrounding waters causes coral bleaching (McManus and Polsenberg, 2004). A similar problem has been highlighted in Zanzibar, where there is a lack of pollution management (Mohammed, 2002). This investigation emphasises the interconnectivity of all the associated activities of people and waste generation, and the need for integration and stakeholder participation. The local authorities have begun the construction of a wastewater treatment plant, but have given little attention to sanitation, the later having a greater impact to social sustainability (disease) than to environmental sustainability. Mohammed (2002) recommended the privatisation of sanitation services in a community with a small economy, this could be a suitable solution for Utila due to the impact of sewage to the environmental and socio-economic elements.

Municipal waste is stored at the town dump, and simply deposited upon the ground. The lack of treatment or adequate storage of such material allows for significant leaching of pollutants, although no data was gathered to prove the contamination of the surrounding soils of food chains, the potential of this being the case is high. The impact of releasing heavy metals and other toxins into the environment can have considerable effects to individual organisms and to whole food chains (Naidu and Morrison, 1994). Due to the topography of Utila, the creation of a municipal landfill is not possible; the only realistic option is to ship to the mainland where it can be disposed. The problem of doing this is that the infrastructure on the mainland is equally as poor and therefore the location of the problem is removed but the overall problem unresolved. Current levels of waste production and pollution, and with the increasing pressure of a growing population the carrying capacity of these ecosystem services may have already be reached or surpassed. Evidence of this is the accelerating phase shift on the reef, where algae are now dominating and the attraction for tourists is decreasing (figure 15). When the carry capacity of an ecosystem is exceeded the ability of

self-regulation diminishes and irreversible damage occurs, a stressed ecosystem is much more susceptible to pests and disease (Alongi, 2002).

The level of urban encroachment into mangrove forests is increasing (Interviewee 22), and the decline in fish nurseries and spawning grounds is reducing fish abundance on the reef (Mumby, 2006, Interviewee 13). Hughes et al., (2007) have shown (on a similar system the Great Barrier Reef (GBR)), that the exclusion of large fish significantly reduces the resilience of coral reefs and their fortitude to recover from bleaching events. Their research discovered that the exclusion of large herbivorous fish, especially parrotfish, promoted algal growth and reduced the fecundity, recruitment and survival of corals. Thus the ecosystem services to fisheries supplied by mangroves are essential in maintaining key fish populations that regulate the coral/algal interactions (Mumby, 2006). Therefore the author recommends the instigation of a marine park and a marine park authority, which can monitor the state of the environment and monitor anthropogenic activities. The creation of the Great Barrier Reef Marine Park Authority (GBRMPA) has allowed for management of the environmental and socio-economic (stakeholder) activities associated with the GBR (an area of 345 000km^2)(Barton, 1997). The zoning of the GBR system allows for different levels of environmental protection and economic exploitation, this is definitely a manageable proposition for Utila; the reef system is significantly smaller. The problem of deciding which areas should have which zoning was experienced upon the Galapagos Islands, but resolved through a four-year pilot study allowing for monitoring the success of each of the zoned areas (Baine et al., 2007). By regulating anthropogenic activities within certain areas pristine areas can be protected and areas in decline can be preserved. The local-scale stewardship of these resources will have outputs that benefit the whole region (Hughes et al., 2007). The inclusion of recreation areas, fishing grounds and 'no-go' areas has facilitated fish populations, which in turn reduces the algal presence on the reef (Hughes et al., 2007). The GBRMPA is also responsible for performing environmental assessment for proposed developments and projects that could affect the system (Barton 1997). The connotations for Utila would be the reduction in unsustainable practices related to the development occurring on the island, potentially reducing the coral/algae phase shift. Therefore it is also recommended that terrestrial zoning occurs; the identification of key environments to terrestrial and marine ecosystem health is necessary. Zoning should determine the amount of development allowed to occur in certain regions, limiting population pressures, moreover the establishment of buffer zones between urban and sensitive ecosystems should be maintained, such buffers have been successful in Mexico (Holguin et al., 2006). The marine park authority could also have jurisdiction of enforcement of these regulations as the impacts of development have implications to the marine system (figure 15).

All of the stakeholders on Utila aware or becoming aware of the damage that their terrestrial activities are causing to marine environment, or as suggested by some individuals' behaviours have remained the same despite changes within society, and previously the environment could cope with their level of resource and ecosystem utilisation (Interviewee 34). Reference has been made to the level of education of the Utilian and mainland Honduran communities (Interviewee 4; Interviewee 27) is it that they are simply unaware of their impact, or are they ignoring the warning signs hoping that the situation will resolve itself?

6.2 The Socio-Economic Sphere

All of the stakeholders are aware of the importance of the dive industry, and more recently the property development sector to the economic growth of Utila (figure 15). The affect of the

economic growth is the purchasing power of individuals and changes in behaviour occur, for example the demand for motorised transport, which is now increasing with affluence (Interviewee 16; Interviewee 31). Transport is an issue in itself and has many associated problems of pollution, which will not be discussed here, but increasing affluence tends to increase unsustainable behaviours. Through the establishment of these industries the whole island has prospered and standards of living have increased, due to the provision of business and employment opportunities. The rate of growth is now slowing and has started to plateau, evidence of this is the supply of hotels and dive operators far out strips the consumer demand, most noticeable during the low season (Interviewee 18). This is causing tensions between rival businesses and stakeholder groups through increased competition of a limited resource, tourists. Competition is becoming fierce and is being skewed by the increasing domination of tourist-orientated businesses by foreign investors, who are out-competing Honduran owned businesses (Interviewee 13; Interviewee 18). In addition mainland Hondurans are migrating to Utila to obtain a better standard of life, and work for a lower wage than Utilians. The Utilian municipal authorities are now facing a dilemma of a growing population with greater demands on services and infrastructure, but are unable to invest in many areas due to a limited budget as an increasing proportion of the population is unemployed. Currently the local authorities rely upon the taxation of foreign investors to increase the municipal budget (figure 15), which is used to invest in infrastructure and services for the community (Interviewee 36). A potential solution to business competition is the limiting of business licences issued to foreign nationals, this could reduce the level of foreign investment in the long-term. This may reduce the income of the municipal budget in the short-term, but sustainability is not achievable within a short time frame. A trial period should be given to assess the appropriate number of licences to be issued. In the short-term infrastructural investment may decrease, and causing a reduction in social and environmental sustainability, but the long-term gains to all of these elements of sustainability should also be considered. The role of this proposition is to encourage economic growth within the Utilian and mainland Honduran stakeholder groups, and to reduce the social tensions between the various stakeholder groups on Utila (figure 15). The increase in social tensions reduces the social capital within a community, and reduces trust and cooperation between different stakeholder groups; these are essential components to a successful sustainable development plan (Christie et al., 2005). In some instances this could lead to certain stakeholder groups deliberately over-exploiting a resource to gain an advantage where they feel they may be discriminated (Interviewee 20). In this instance this would lead to a decrease in environmental sustainability initially, and the after affects of socio-economic sustainability decline would be realised after a longer time period.

The problem of the increasing population upon Utila has many associated problems (figure 15); research on the Galapagos Islands noted that population increases were determined by the level of tourism and their demand for support infrastructure (Baines et al., 2007). According to de Groot (1983) the number and the behaviour of Galapagos Island visitors must be regulated to minimise environmental impact. Therefore limit the numbers of tourists visiting the islands annually, the visas can be checked at the airport and port on the mainland, the only ways to gain entry to Utila, the number of visas should be set after a trial period to ensure a balance between socio-economic and environmental factors for Utila. A recommendation to prevent further pressures on the environment from increasing numbers of tourists, a visa system could be put in place. People visiting Utila or the Bay Islands must have one of a limited number of visas to visit the island(s), and the cost of the visa could aid in funding the marine park authority. In addition to reduce the emigration of people living on Utila, an Utilian residency visa, is recommended. To be eligible, proof of employment or financial independence must be asserted, this ensures that unemployment levels do not rise and the local authorities attain information regarding population pressures on

services and infrastructure. With the federal law pertaining to the Bay Islands becoming a tax-free zone, the Bay Islands are able to make their own by-laws and therefore such an initiative is a reality. Within the short-term such an initiative will have limited affected, but the in the long-term resources will be available for longer periods of time before being exhausted. The presence of the mainland and tourist resident communities has accelerated the inevitable stress to the limited natural resources, especially freshwater. Concerns are increasing over the scarcity of water and the depleting natural reserves, and the possibility of having no sources of freshwater on the island. The local authorities have acted in relation to this problem by the construction of a desalinisation plant. The running costs of such an operation are high and therefore the cost of water could make this essential resource inaccessible to some. The lack of water is a key component to the level of sanitation on the island. The lack of sanitation is having affects to the environment but more critically the outbreak of waterborne diseases seems inevitable. This will affect the whole island significantly especially the poorer areas where the population densities are the highest. The presence of disease upon a small tourist island will initially (short-term) affect the social sustainability and then the economic sustainability, tourists will not travel to areas where there is a cholera or typhoid epidemic, no matter how cheap the diving is, an important long-term affect to the socio-economic element of sustainability.

A recommendation is that tourists burden the cost to the municipality of environmental protection, waste management and policing. An increase in the price of diving as a taxation to the municipality would allow for investments in infrastructure and services, 61% of the tourist surveyed said they would return if the price increased, and 69% replied that if the condition of the reef decreased they would not return. Therefore the tourists are willing to pay to ensure that the reef is protected. Members of UDSEC would highlight that there is a daily fee (US$3) for divers that goes to the municipality but so far little has been done towards the protection and conservation of the reef. If the instigation of a previous recommendation of a marine park authority was achieved this autonomous organisation could collect these funds to enforce environmental laws and protect and monitor the environment, in addition to conducting stakeholder workshops to ensure socio-economic factors are considered and ensure a bio-centric view does not dominate objectives and goals. An example of a successful authority is the GBRMPA, which tries to balance all the elements of sustainability through stakeholder interactions (Barton 1997). Divers are charged a daily fee that funds the daily activities of the organisation and its staff. A problem faced by this authority is the lack of funds to be able to police the whole expanse of this area, this would not be a problem if such an organisation were to be instigated on Utila (previously recommended by the author) where the reef system is much smaller and running costs would be much lower (Barton 1997).

An important stakeholder is the tourist and they influence the island of Utila, they are often the principle driver behind many of the processes and actions occurring (figure 15). A problem of the low-budget tourist industry to Utila is drugs, the prevalence of drugs especially heroine and cocaine is having an effect upon the youth culture of Utila. The main demand is coming from the tourists, but the lack of activities for the resident youth is leading them to experiment with drugs, leading to greater incidences of anti-social behaviour and crime. Heavily linked to the drug problem according to many of the stakeholder groups is the mainland Honduran community, this is the main avenue of supply. Drug culture and addiction often lead to crime in order to obtain money for the next fix, increasing crime rates is an influential social problem and also an important factor within the tourist industry. To minimise the crime and reduce drug prevalence examples have to be set, to any individual found to be guilty, by setting a precedent much can be achieved (Interviewee 9).

6.3 Sustainability of Utila

The actions of all the stakeholders of Utila are degrading both the terrestrial and marine environments, thus the future of Utila appears to be jeopardy, and therefore a sustainable development plan needs to be initiated by the Utilian authorities. The problem with ensuring sustainability within one sphere is the direct impact it has upon another sphere, in the majority of cases causing a reduced level of sustainability to the other sphere, therefore monitoring by an authoritative organisation is required, such as the GBRMPA. Institutional transparency and legitimacy are key components, Hondurans is a corrupt country (Transparency International, 2005) and problems could arise during such an initiative. Institutions are vital to the success of sustainable development, their role is to mediate and resolve conflicts between stakeholder groups, ensure compliance and represent stakeholders that have no voice. The role of the NGO now becomes important, their ability to represent minorities and the environment, key stakeholders which will be greatly impacted by the implementation of such an initiative. A problem facing the authorities of Honduras as a whole and Utila is legitimacy. Legitimacy is a vital component of an institution, a constituent that the NGO's on Utila currently lack, they are viewed as marketing strategies rather than a benefit to the environment or society of Utila. The authorities of Honduras, including Utila also lack legitimacy, they are recognised as being corrupt by various stakeholders on Utila. A lack of legitimacy reducing trust and capacity building between stakeholders, in addition to reducing the potential for the funding a long-term project of sustainable development.

A sustainable development plan needs to be framed upon sound natural and social scientific data regarding the ecosystem structure and function and the system dynamics of the stakeholder groups and societal interactions. Within the formulation of such a plan, milestones should be set to and to ensure the measures utilised are effective, within the short-, medium- and long-term. A successful sustainable management plan is one that will progress past its point of termination and still function effectively (Christie et al, 2005). A suitable time frame would be 30-years (one generation), this allows for changes in social behaviours and allow for adaptations based on these behaviours and changes in society. The indicators used should reflect the key areas of sustainability that the project is to address, and cover each of the elements of sustainability (Bell and Morse 2003:81). It is important to ensure as much as possible, that indicators are easily measurable (an indicator can be made up of several components). By ensuring the ease of measuring, monitoring can be achieved annually and therefore allowing a progressive analysis of the project. Possible indicators for Utila derived from the importance of the coral reef and data from the stakeholder analysis could be:

Environmental indicators: Reef Health, Mangrove Health, Biodiversity and Nutrient Loading of Water.

Socio-economic indicators: Level of Employment, Municipal Economy, Ratio of Honduran:Foreign businesses, Health, Level of Education, Access to Water, Crime Rate, Prevalence of Drugs.

It is important to note that to sustainably use and manage mangrove forests and other tropical ecosystems a clear understanding of direct and indirect human impacts must be achieved (Dahdouh-Guebas, 2002), thus all stakeholders both direct and indirect must be identified and their

strategies understood (Cormier-Salem, 1999). Stakeholder workshops are effective ways to obtain stakeholder views, in addition by holding workshops biannually stakeholders can be informed of how the sustainability plan is progressing through the use of the indicators. By ensuring a whole system understanding the generation of both social and environmental benefits can be achieved, in addition to the equitable distribution of these benefits among stakeholders (Christie et al, 2005). A participatory process involving all stakeholders can achieve equitable distribution of benefits in addition to creating a sustainable management plan, as the level of use of the mangroves and associated ecosystems of each stakeholder group will be defined (Holguin et al, 2006). Within Honduras and whole the Central American region many integrated coastal zone management initiatives have been implemented with the support of governments and non-government organisations (Windevoxhel et al, 1999), the successes and failures of these projects can be used as a platform and learning experience in which to implement such an initiative on Utila. By analysing previous implementation strategies and results and by ensuring stakeholder participation underlying causes to economic, environmental and social problems can be identified and defined and aid in creating a sustainable management plan (Gladstone et al, 1999).

The key area to gain sustainability is education and information, not only within the schools and younger generations, although these people are a crucial part of the future to Utila, but to all stakeholder groups, especially the tourists. The tourists must comprehensively understand the impact of their visit to Utila. The stakeholders of Utila must gain a greater understanding of each other's needs and the impact of their direct and indirect actions to other stakeholders and to the environment. Activities in other areas of Honduras must also be included within the scope of the sustainable development plan, the mouth of the river Ulúa on the mainland of Honduras, with a catchment area of 22 000km^2, opens in close proximity to Utila (Harborne et al., 2001). The consequences of deforestation and soil erosion within this catchment area significantly increase the risk of eutrophication of the surrounding waters and sedimentation of the reef. The inclusion of all stakeholders is important to realise the whole demand on the system and to assess what levels and standards are acceptable, compromises will have to be made. It is crucial to the success of the plan that balancing of stakeholders demands are understood and compensated to ensure the overall sustainability (Christie et al., 2005). The Mesoamerican barrier reef is a transboundary resource, and is influenced by activities in many other countries and their stakeholders (Aguilar-Støen, M., and Dhillion, S. 2003); this must be taken into consideration when devising the sustainability plan.

7.0 Conclusion

The coral reefs of the world are under significant threat natural climatic phenomena. Therefore the future of coral reefs is limited, but with the synergistic effects of localised anthropogenic activities the time frame for their longevity could be drastically curtailed. There is little or no common ground between the land and sea, activities on land continue to jeopardise the marine resources, these effects can be minimised through regulations and education allowing for slower degradation and prolong the inevitable. A major problem facing marine conservation is the open access of the marine environment and the lack of husbandry. Exploitation and pollution of these resources is highly unregulated, the management of such resources is complicated further by the transboundary affect. The Mesoamerican barrier reef is no exception, four countries have coastlines adjacent to this resource. Trans-national (Mesoamerica), national (Honduras), regional (Bay Islands) and local (Utila) sustainability initiatives must be implemented. The initiation of sustainable development plans encompassing these spheres will give a comprehensive action plan, ensuring stakeholder participation at all levels. The incorporation of all these levels can allow for the mitigation of transboundary effects as regions and nations act together towards a common goal. This is a large ambition, especially for the economies associated with this part of the world, therefore it is imperative that local sustainable development plans are initiated to gain a foundation and ensure socio-economic and environmental sustainability for communities dependent upon these resources. Therefore Honduras as a country and Utila as a municipality must endeavour to address sustainability and implement sustainable development action plans. The various recommendations discussed above may not be suitable as direct action plans, but facets of each could be utilised to form an appropriate management policy for Utila, a part of a bottom-up process towards sustainability in the Mesoamerican region. The instigation of a marine park and a marine park authority will allow regulation of the marine resources upon which Utila is so dependent. In addition to reducing population pressures through visa attainment will reduce the level of destructive impacts to the marine resources and increase the socio-economic situation for Utila's residents. The use of indicators is essential to the assessment and success of a sustainable development initiative. Population pressure and the associated pollution from development and waste generation are major influences to coral reefs and mangrove forests. It may appear to be unjust to prevent the movement of people to areas of economic growth where they have the opportunity to improve their quality of life. The problem is based around the balance of socio-economic and environmental sustainability, the case of Utila highlights the pressures of an increasing population upon a sensitive environment on which a whole communities economy is dependent. If Utila can formulate a progressive sustainable development plan, involving all the stakeholder groups and demonstrate how sustainability can be achieved in the short-term and long-term, this would serve as a beacon project to similar tropical islands within Mesoamerican and the Caribbean.

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9.0 Appendix

Appendix 1. *Interviewee basic information*

Interviewee 1. A male tourist resident, residing upon Utila for two and a half years, employed in the dive industry. Interviewed on 9th February 2007.

Interviewee 2. A female from the Honduran mainland, residing on Utila for five years, is a fulltime mother. Interviewed on 28th February 2007.

Interviewee 3. A female Utilian, employed in the dive industry. Interviewed on 3rd February 2007.

Interviewee 4. A male Utilian, employed in retail and the real estate sector. Interviewed on 24th January 2007.

Interviewee 5. A male tourist-resident, residing on Utila for five and half years, employed in the dive industry. Interviewed on 1st February 2007.

Interviewee 6. A female mainland Honduran, residing on Utila for twenty-three years, employed in the restaurant industry. Interviewed on 15th February 2007.

Interviewee 7. A female Utilian, employed in the retail sector. Interviewed on 3rd February 2007.

Interviewee 8. A male Utilian, employed in the restaurant industry. Interviewed on 19th February 2007.

Interviewee 9. A male mainland Honduran, residing on Utila for thirty-five years, a member of the local authorities and employed in the retail sector. Interviewed on 20th February 2007.

Interviewee 10. A male tourist-resident, residing on Utila for sixteen months, employed in the dive industry. Interviewed on 27th January 2007.

Interviewee 11. A male Utilian, employed in the Hotel and restaurant industry. Interviewed on 19th February 2007.

Interviewee 12. A female mainland Honduran, residing on Utila for two years, employed in the restaurant industry. Interviewed on 28th February 2007.

Interviewee 13. A male tourist-resident, residing on Utila for six years, employed in the dive industry. Interviewed on 8th February 2007.

Interviewee 14. A female mainland Honduran, residing on Utila for two months, unemployed. Interviewed on 27th February 2007.

Interviewee 15. A female mainland Honduran, residing on Utila for four years, employed as cleaner. Interviewed on 27th February 2007.

Interviewee 16. A male tourist-resident, residing on Utila for twelve and half years, employed in the dive industry. Interviewed on 20th February 2007.

Interviewee 17. A female tourist-resident, residing on Utila for nine months, employed by an NGO. Interviewed on 29th January 2007.

Interviewee 18. A female Utilian, employed in the hotelier industry. Interviewed on 27th January 2007.

Interviewee 19. A female tourist-resident, residing on Utila for four years, employed by an NGO. Interviewed on 25th January 2007.

Interviewee 20. A male Utilian employed in the dive industry. Interviewed on 18th January 2007.

Interviewee 21. A male tourist-resident, residing on Utila for two and a half years, employed in the dive industry. Interviewed on 1st February 2007.

Interviewee 22. A male Utilian employed in the hotelier and real estate industries. Interviewed on 1st February 2007.

Interviewee 23. A male tourist-resident, residing on Utila for fourteen years, employed in the dive industry. Interviewed on 30th January 2007.

Interviewee 24. A male tourist-resident, residing on Utila for thirty-six years, employed in the retail sector. Interviewed on 23rd January 2007.

Interviewee 25. A male tourist-resident, residing on Utila for one year, employed in the dive industry. Interviewed on 29th January 2007.

Interviewee 26. A male tourist-resident, residing on Utila for one year, employed in the dive industry. Interviewed on 27th January 2007.

Interviewee 27. A male Utilian, employed in retail and hotelier industry. Interviewed on 24th January 2007.

Interviewee 28. A male mainland Honduran, residing on Utila for fifteen years, employed as a security guard. Interviewed on 28th February 2007.

Interviewee 29. A male Utilian, employed in the dive industry. Interviewed on 18th February 2007.

Interviewee 30. A female mainland Honduran, residing on Utila for six years, a fulltime mother. Interviewed on 27th February 2007.

Interviewee 31. A male tourist-resident, residing on Utila for two years, employed in the real estate industry. Interviewed on 8th February 2007.

Interviewee 32. A male tourist-resident, residing on Utila for two years, employed by an NGO. Interviewed on 8th February 2007.

Interviewee 33. A male Utilian, employed in the dive industry. Interviewed on 27th February 2007.

Interviewee 34. A tourist-resident, residing on Utila for six months, employed in the dive industry. Interviewed on 9th February 2007.

Interviewee 35. A female tourist-resident, residing on Utila for twenty-five years, employed in the real estate industry. Interviewed on 22nd January 2007.

Interviewee 36. A male Utilian, a member of the local authorities. Interviewed on 7th February 2007.

Appendix 2. *A sample of the type of questions asked to the stakeholders.*

- How long have you lived on Utila?
- What made you come here?
- Where were you living before?
- What is your occupation?
- During your time here what do you consider to be the greatest changes to Utila?
- What has triggered these changes?
- How do you see these changes affecting Utila into the future?
- How have the local and national authorities and institutions acted towards these changes?
- What is your opinion of these authorities/institutions?
- How does the rest of the island perceive them?
- How do you feel about the developers on the island, how does this group generally interact?
- What do you think about the tourist industry?
- Are there any NGO's on the island that do good work?
- Ho do you perceive the mainlanders who have emigrated to Utila?
- Have they impacted you directly?
- Do you have any idea of how they support themselves?
- How do other islanders feel towards them?
- Whilst being on Utila have you experienced a hurricane?
- How were you impacted?
- How where other islanders impacted?

Appendix 3. *A sample of the tourist survey.*

Why did you come to Utila?

Fun diving	☐	Snorkelling	☐
Learn to dive	☐	Whale shark/dolphin spotting	☐
Advanced/rescue/DM/IDC	☐	Other	☐

What factors did you consider when choosing Utila?

Cost of living	☐	Number/type of fish	☐
Price of diving/courses	☐	The coral coverage	☐
Other recommendations	☐	Whale sharks	☐
Others (pleas specify)	☐		

Which factor was most important?
If the price of diving/courses increased on Utila would you still come?

Yes ☐ No ☐ Don't Know ☐

Please comment
What do you think about the condition (health) of the reef?

Good ☐ Reasonable ☐ Poor ☐ Don't Know ☐

If the condition of the reef deteriorated would you come back to Utila to dive, if prices remained the same?

Yes ☐ No ☐ Don't Know ☐

Please comment
How long are you planning on staying in Utila?

How long will you be travelling for?